

AIRS Data Assimilation: Bias Correction and Its Impact on Numerical Simulations of Tropical Cyclones

Zhaoxia Pu and Lei Zhang
Department of Atmospheric Sciences
University of Utah

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Objectives

- Evaluate the impact of AIRS retrieved temperature and moisture profiles on numerical simulations of tropical cyclones (TCs)
- Examine the relative importance of assimilation of temperature and moisture profiles in numerical simulations of TC formation and intensity changes
- Assess the quality of AIRS retrievals near TCs and its impact
 - Comparison of AIRS retrievals with dropsonde observations from recent field programs (NAMMA and T-PARC)
 - Bias correction and its impact on data assimilation and TC simulations

Acknowledgements: NASA AIRS Science Team
NASA NAMMA Science Team
ONR T-PARC/TCS08 Science Team
Drs. Kakar and Lee, NASA/HQ

Model and data assimilation system

An advanced research version of mesoscale Weather Research and Forecasting (WRF) model

WRF 3DVAR data assimilation system

AIRS Data

AIRS retrieved atmospheric temperature and moisture profiles

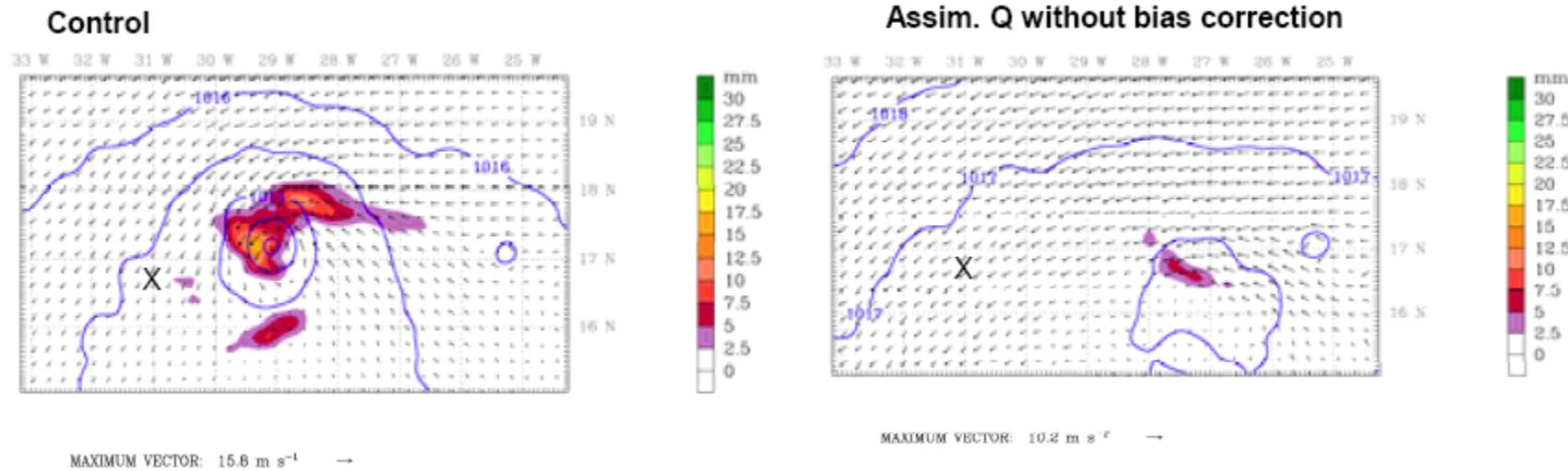
Version 5 L2 data products

The data quality flag: “best” and “good”

Problem

Impact of AIRS/Aqua retrieved moisture (Q) profiles on the forecast of Tropical Storm Debby's development

24-h forecast at 1200UTC 23 August 2006 without (control) and with assimilation of Q

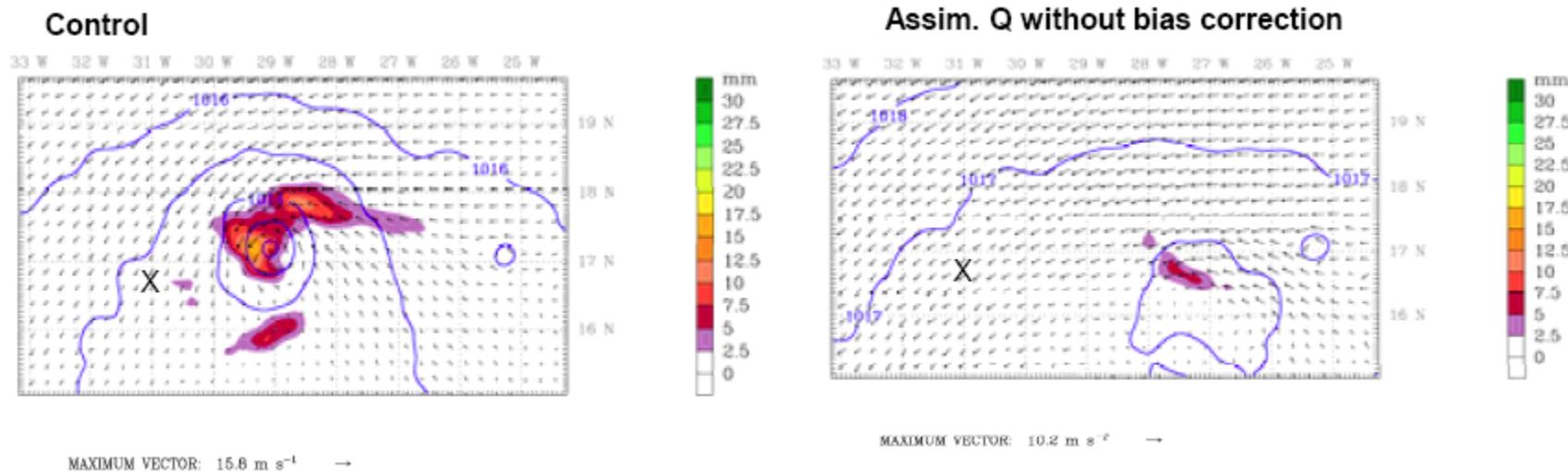


Assimilation of Q causes the decay of the storm. What is wrong?

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Assimilation of Q causes the decay of the storm, what is wrong?

Negative moisture increments are found in the storm environment.
Dry biases in data?

Comparison of AIRS temperature and moisture profiles with dropsonde observations from recent field programs

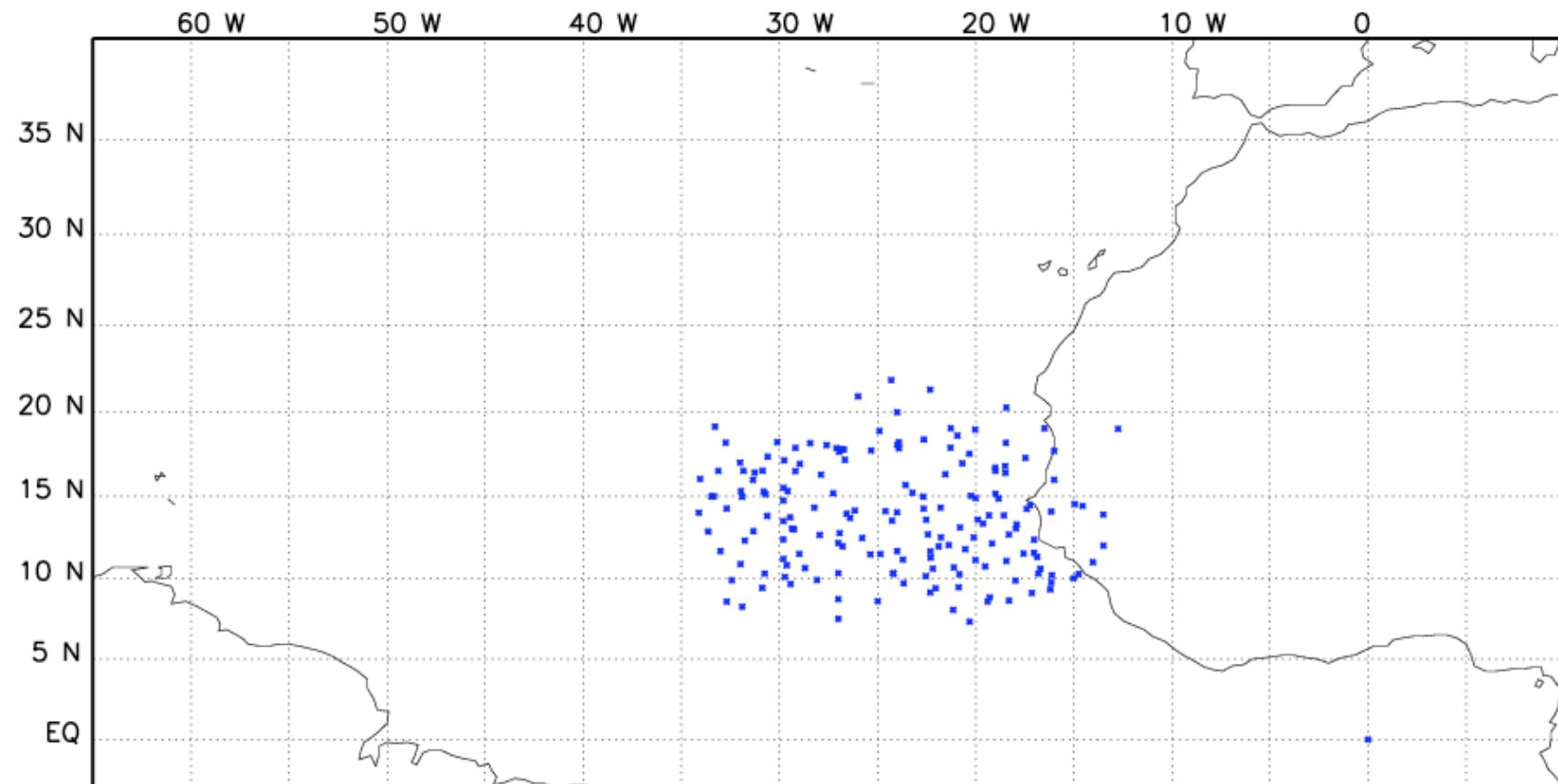
- NASA African Monsoon Multidisciplinary Analyses (NAMMA)

East Atlantic Ocean; August to September 2006

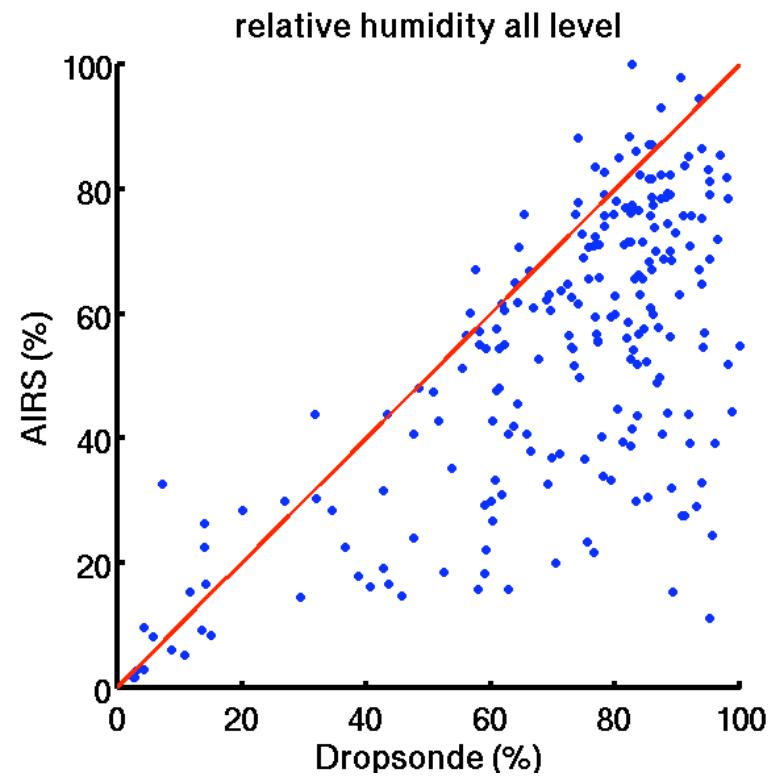
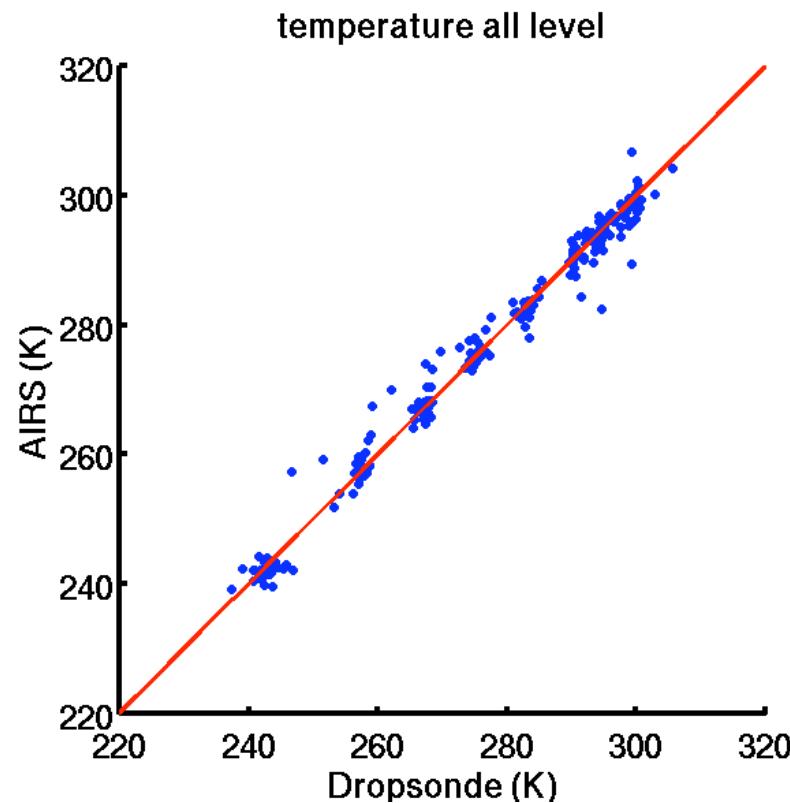
- The THORPEX Pacific Asian Regional Campaign (T-PARC)
Tropical Cyclone Structure Field Program (2008) – TCS08

Western Pacific; August to September 2008

NAMMA dropsonde data locations

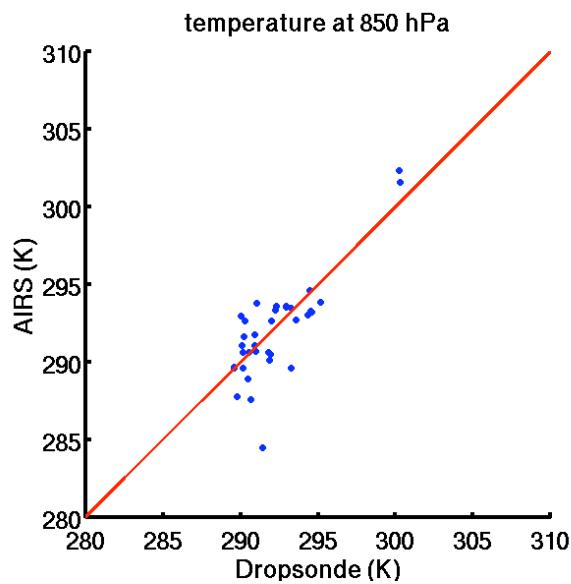
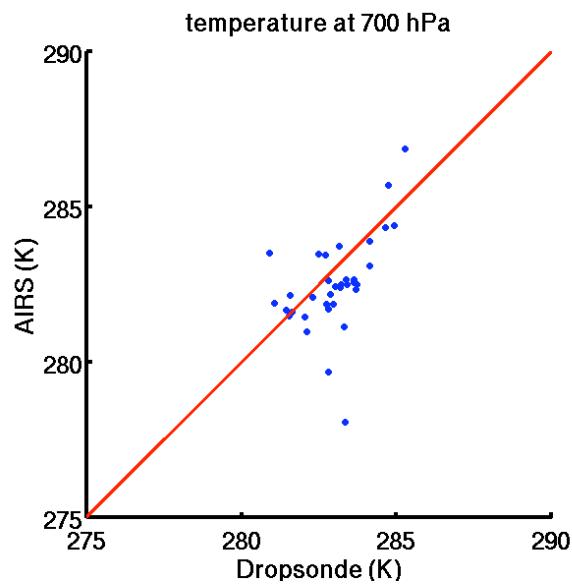
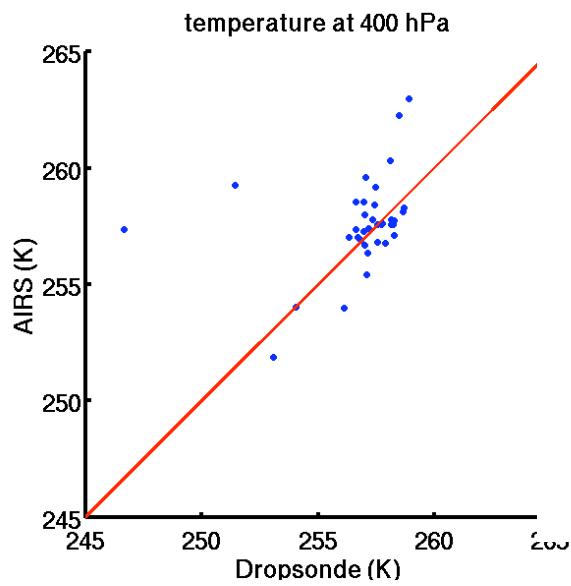


Overall Comparison: AIRS vs. NAMMA dropsondes



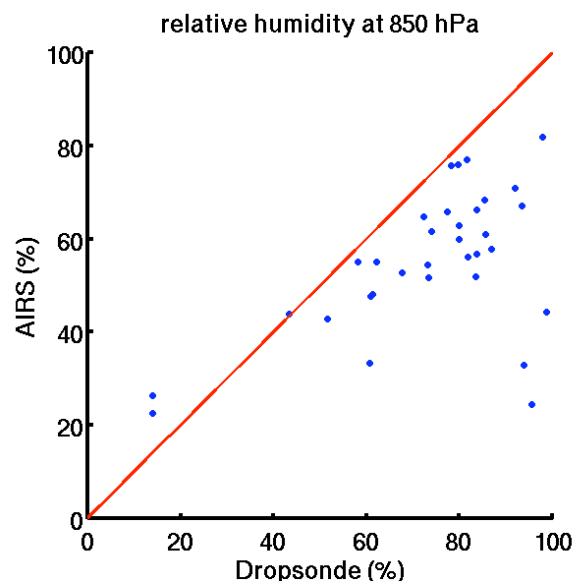
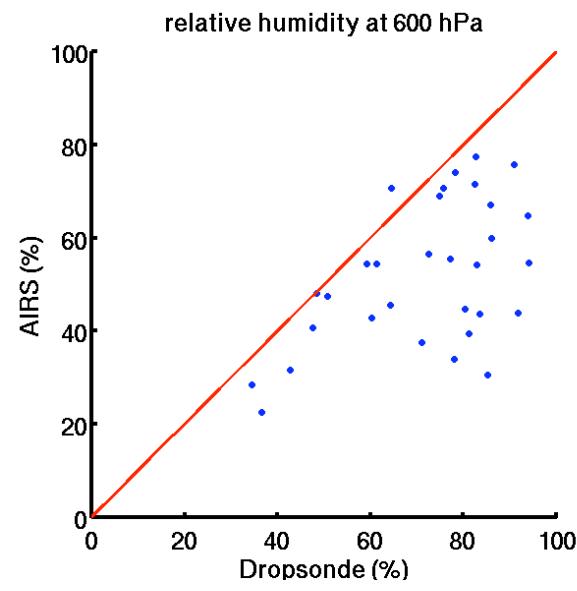
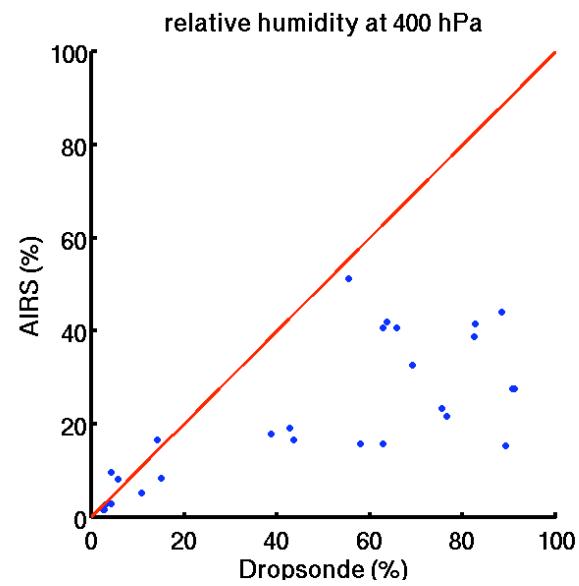
Temperature

Relative Humidity



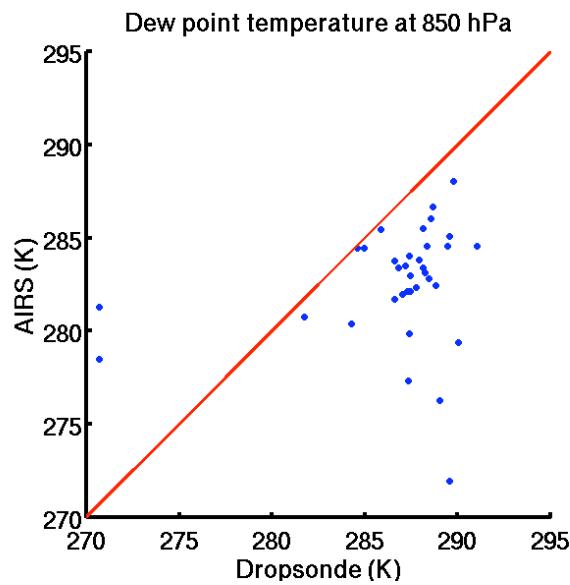
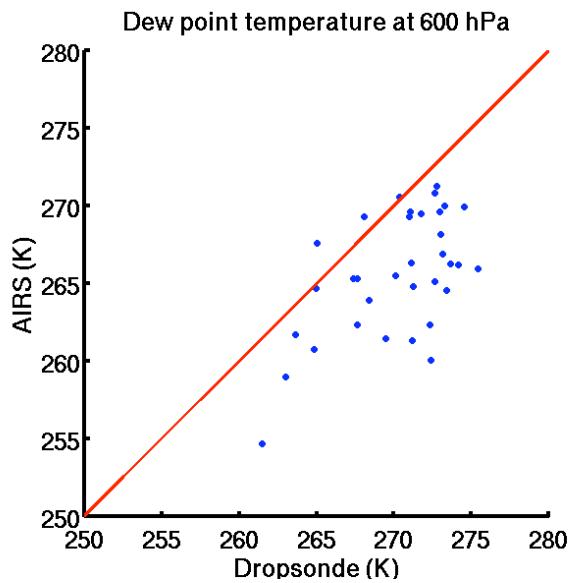
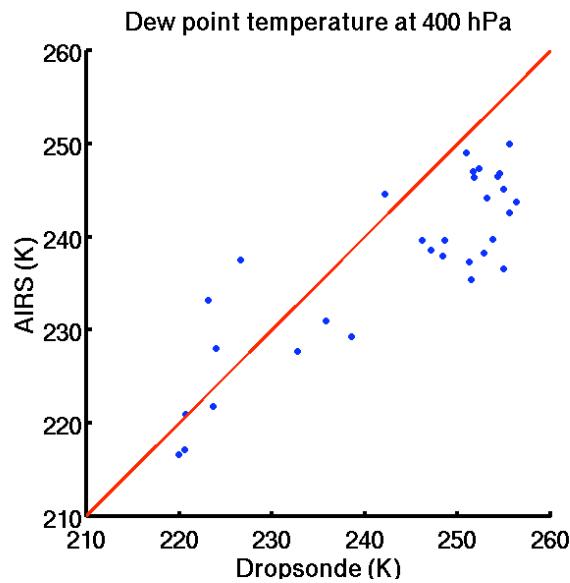
AIRS vs. NAMMA dropsondes

Temperature at 400 hPa, 700 hPa
and 850 hPa



AIRS vs. NAMMA dropsondes

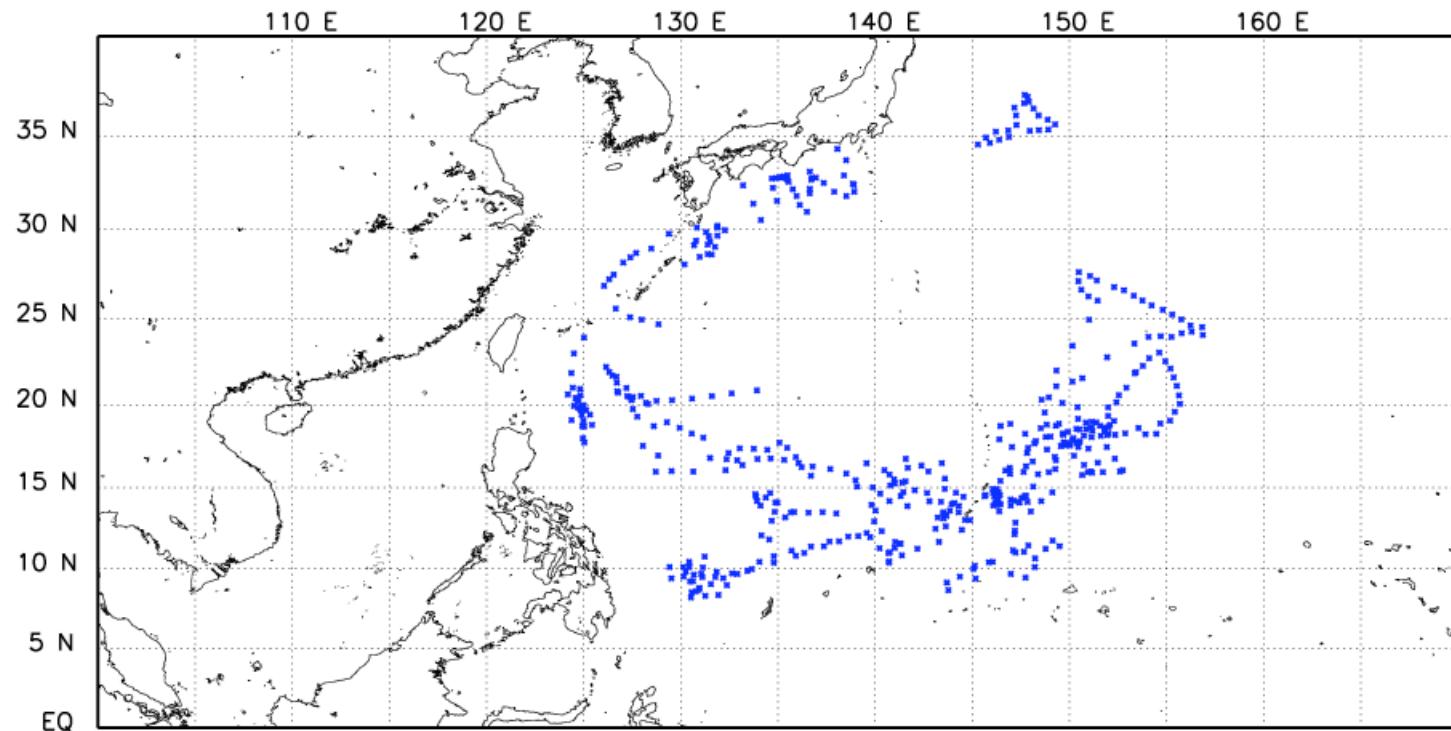
**Relative humidity at 400 hPa, 700 hPa
and 850 hPa**



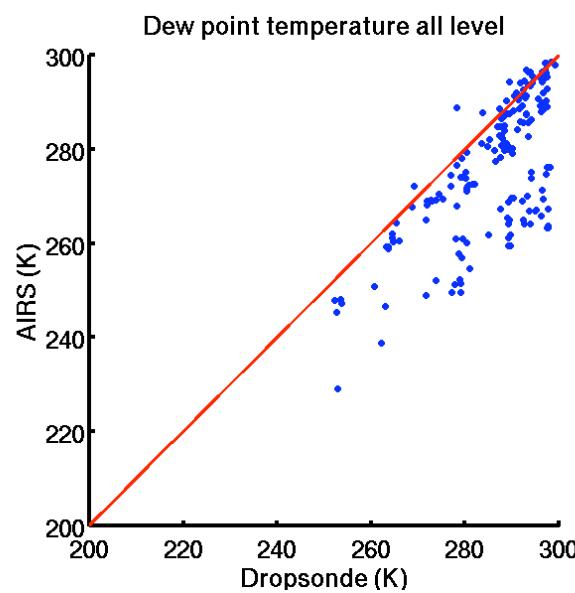
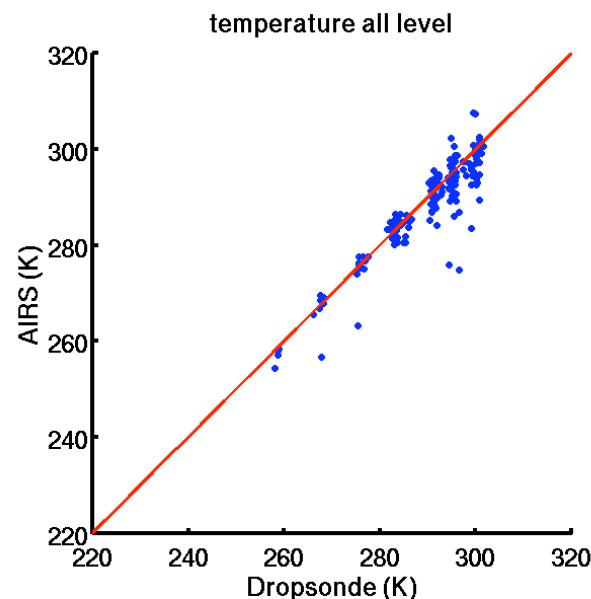
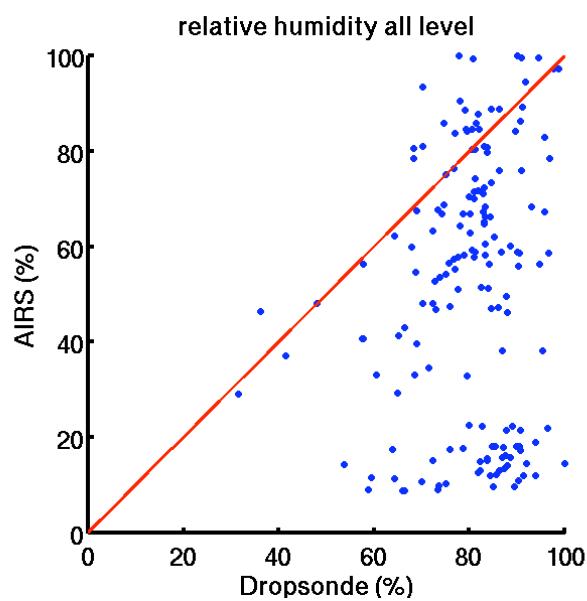
AIRS vs. NAMMA dropsondes

**Dew point temperature at 400 hPa,
600 hPa and 850 hPa**

T-PARC dropsonde data locations

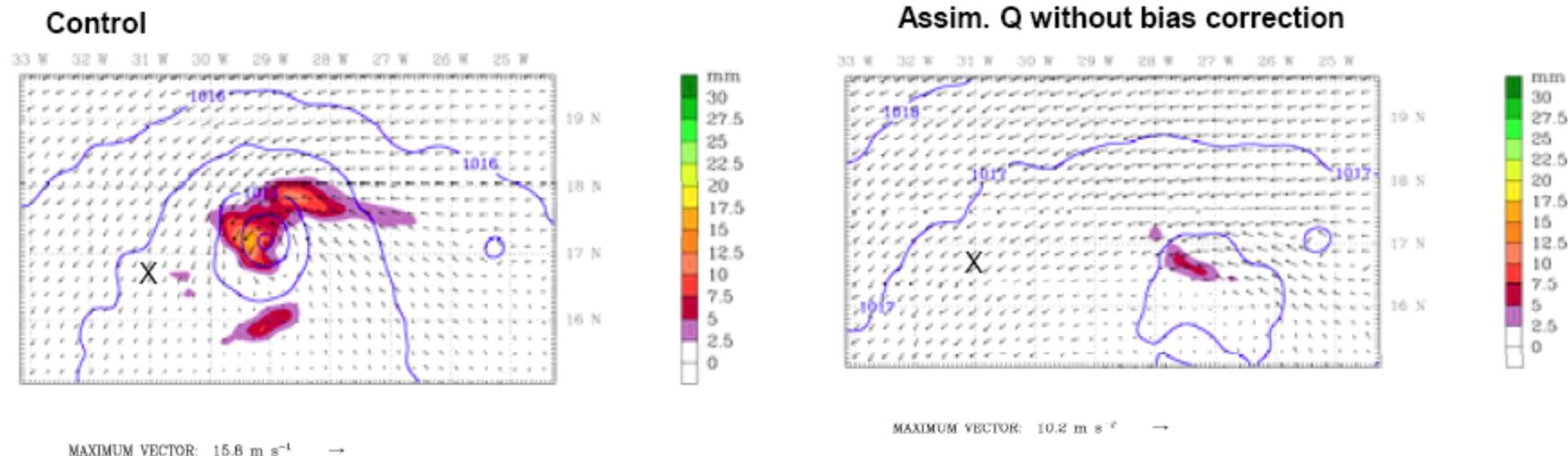


Overall Comparison: AIRS vs. T-PARC dropsondes



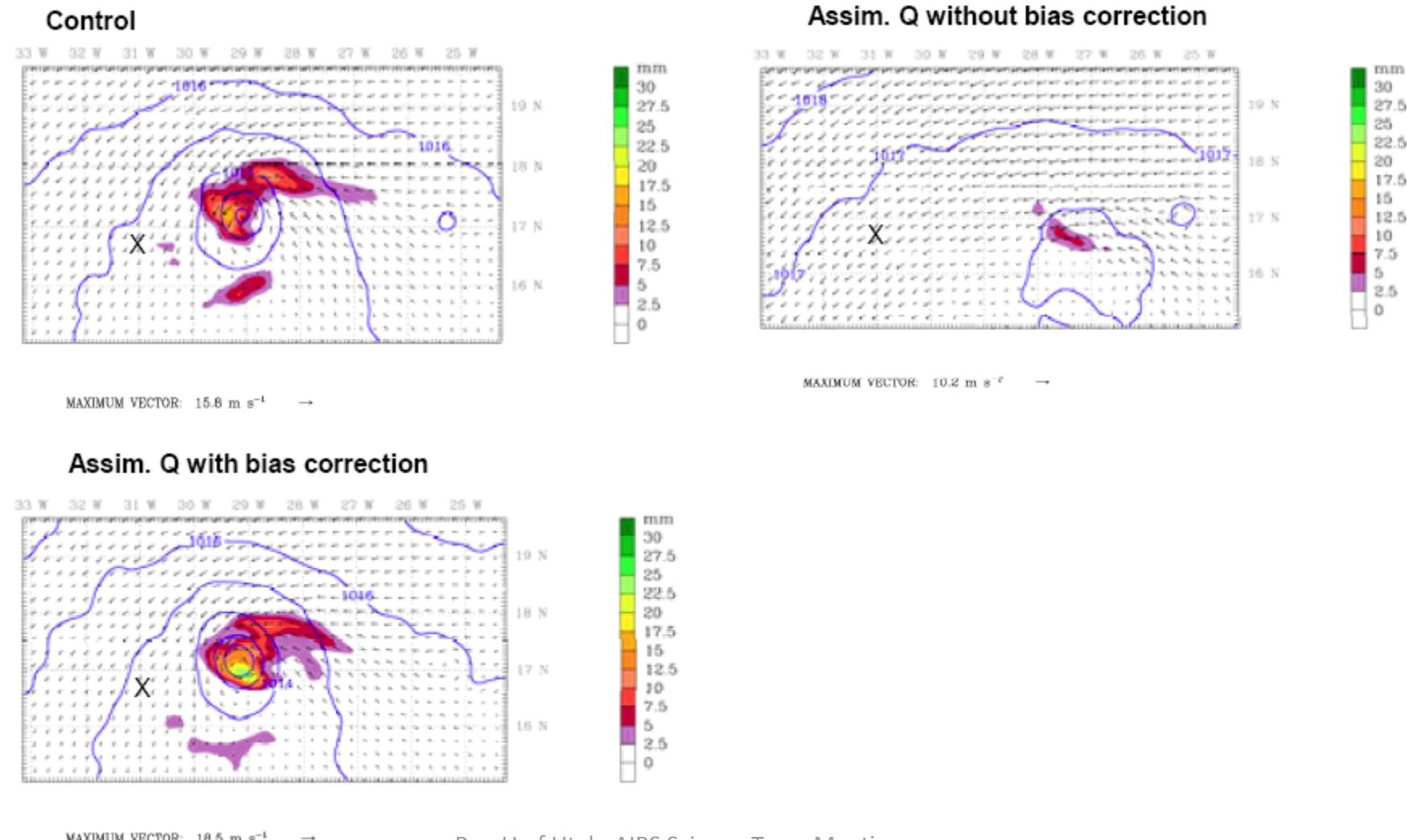
Impact of AIRS/Aqua retrieved temperature (T) and moisture (Q) profiles on the forecast of Tropical Storm Debby's development

24-h forecast at 1200UTC 23 August 2006



Impact of AIRS/Aqua retrieved temperature (T) and moisture (Q) profiles on the forecast of Tropical Storm Debby: Impact of bias correction

24-h forecast at 1200UTC 23 August 2006

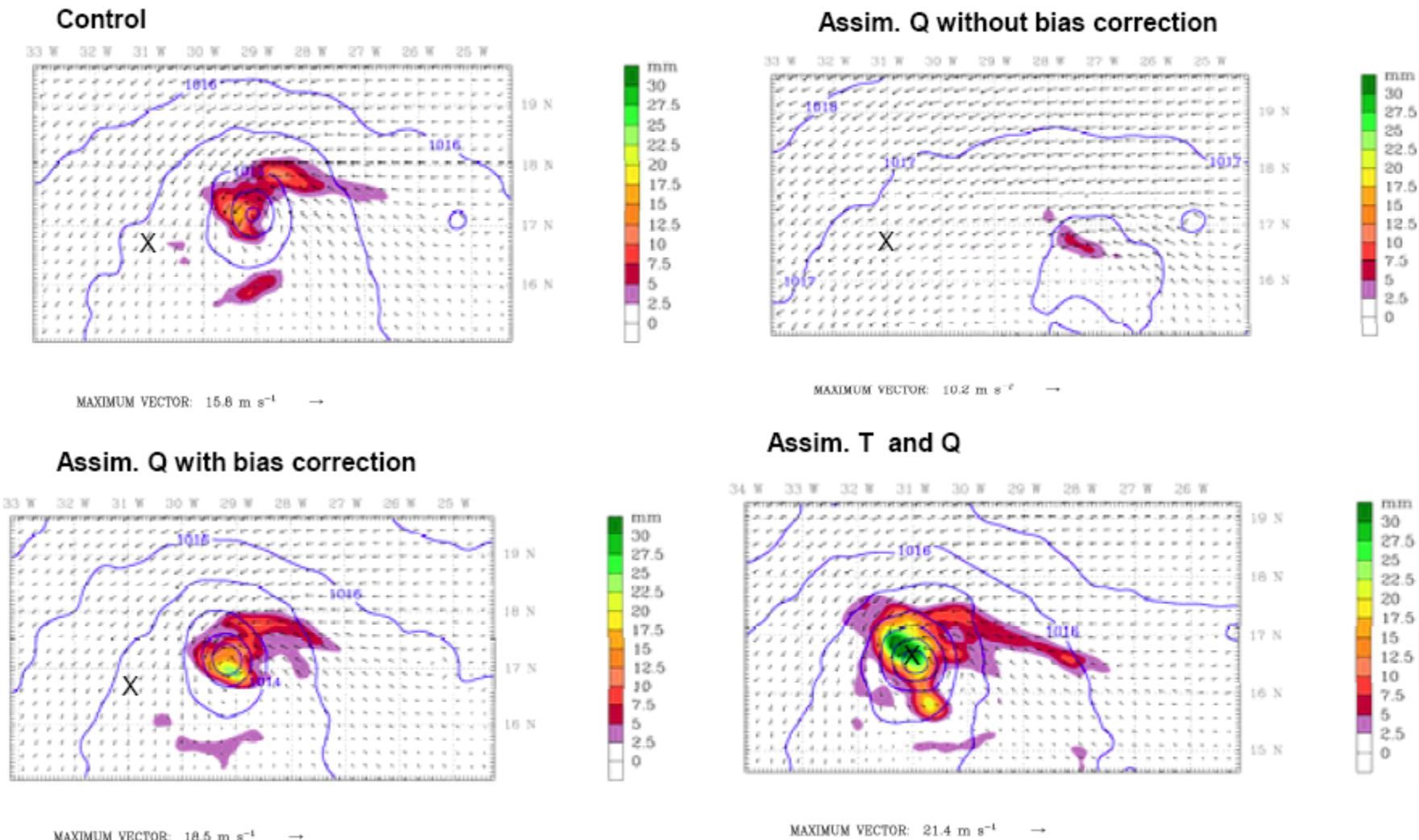


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Impact of AIRS/Aqua retrieved temperature (T) and moisture (Q) profiles on the forecast of Tropical Storm Debby's development

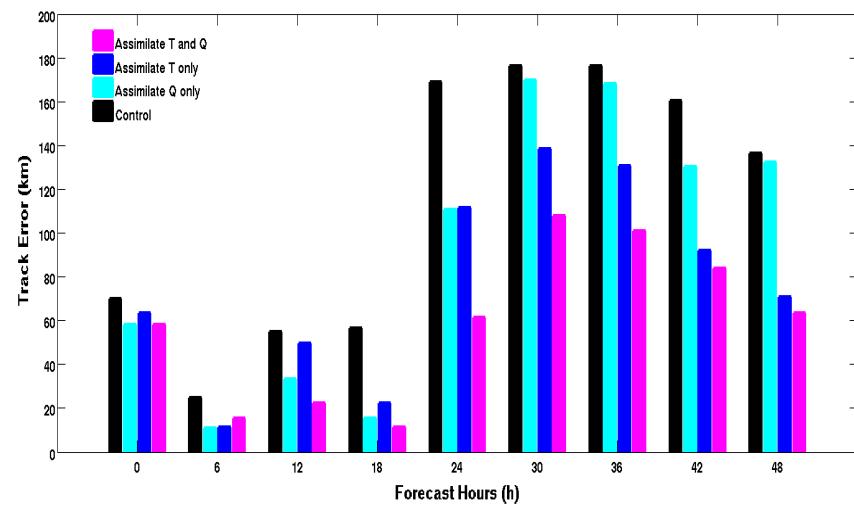
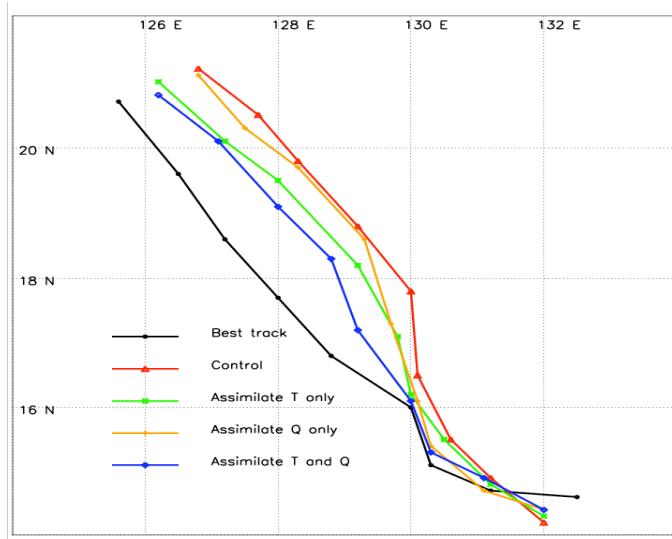
24-h forecast at 1200UTC 23 August 2006



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AIRS data impact on the numerical simulation of Super Typhoon Jangmi



**Forecasted track during
06 UTC 25 to 06 UTC 27 Sep 2008**

Concluding Remarks

- Dry biases are found in AIRS retrieved moisture profiles; biases in the temperature field are somewhat mixed (cold/warm) in different pressure levels
- The forecast of Tropical Storm Debby's development is very sensitive to the assimilation of moisture profiles (Q).

Without bias correction, the assimilation of moisture profiles causes the storm to decay. With bias correction, the assimilation of moisture data results in a reasonable tropical cyclone simulation.

- The assimilation of temperature profiles has resulted in significant improvement in the track forecast.